Laboratory results: High-speed high-magnification digital videos of protists (Protist Behavior and Imposed Flow project)

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Project
» Linking Propulsive Morphology, Swimming Behavior and Sensory Perception by Marine Planktonic Protists to their Trophic Roles within Marine Food Webs (Protist Behavior and Imposed Flow)

Contributors	Affiliation	Role
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Dataset Description

The investigators have obtained more than 3 terrabytes (TB) of high-speed high-magnification image/video data that document protist behavior and interactions for a wide range of species. Data are still being analyzed. The investigators will sort the video clips to post the best ones online, and will coordinate access to data through BCO-DMO. The high-speed high-magnification videos can currently be made available upon request.

Methods & Sampling

The investigators used their in-house built High Speed Microscale Imaging System (HSMIS) and Micro Particle Image Velocimetry (uPIV) system to observe protist swimming behavior, cell-cell interactions, and imposed flow fields. These systems achieve vertically oriented sub-millimeter fields-of-view (1024x1024 pixels) at millisecond temporal resolution and are suitable for observing protists in a reasonably large water vessel. The imaging systems are able to provide image/video data on protist behavior and interactions with unprecedented spatial and temporal resolutions. The protist species that were observed included: (1) the loricate tintinnid ciliate *Amphorides quadrilineata* (100-120 um lorica length) suspension feeding on 5 um *Isochrysis galbana* and on 3 um polystyrene particles, (2) the ciliate *Strombidium* sp. (~60 um diameter) suspension feeding on 3 um polystyrene particles, (3) the predator-prey interaction between the dinoflagellate predator *Gyrodinium spirale* (65-90 um length) and the dinoflagellate prey *Peridinium foliaceum* (~30 um diameter), (4) the jumping ciliate *Mesodinium rubrum* and its cryptophyte prey, and (5) the toxic dinoflagellate *Alexandrium fundyense* in free swimming.

So far, the investigators have obtained more than 3 TB high-speed high-magnification image/video data that document protist behavior and interactions for a wide range of species. All these image data are backuped at least by two copies and stored in the Jiang lab at Woods Hole Oceanographic Institution (WHOI). The investigators are still analyzing the data and will sort the video clips to post the best ones online. The high-speed high-magnification videos will be available upon request.

Data Processing Description

Raw image data are in .tif format.

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Parameters

Parameters for this dataset have not yet been identified

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Project Information

Linking Propulsive Morphology, Swimming Behavior and Sensory Perception by Marine Planktonic Protists to their Trophic Roles within Marine Food Webs (Protist Behavior and Imposed Flow)

Coverage: US coastal North Atlantic water, and US coastal Gulf of Mexico water

Description from NSF award abstract:
One of the central issues in biological oceanography is to understand the processes that regulate the biomass and distribution of phytoplankton in the ocean. The fate of most phytoplankton is to be consumed by grazers, and it is now generally accepted that marine planktonic protists are the most important grazers on phytoplankton, and that grazing by protists can fundamentally affect phytoplankton biomass and distribution in the ocean. Protists can become temporarily very abundant (up to tens of thousands per liter) and can grow nearly as rapidly as phytoplankton do, which gives them great potential to regulate phytoplankton populations. Adaptations by protists to feed selectively on the fastest growing species of phytoplankton and to reduce predation by metazoan zooplankton should enhance the coupling between phytoplankton growth and grazing, and therefore promote planktonic ecosystem stability. Compared to larger metazoan zooplankton such as copepods, relatively little is known about the morphological and behavioral adaptations in protists for selective feeding and predator avoidance.

The PIs will study details of selective feeding behavior and predator avoidance behavior of free-swimming planktonic protists in 3-dimension using high-speed video. Under the same conditions, they will measure flow fields imposed by individual free-swimming protists using a time-resolving stereo micro-particle image velocimetry (microPIV) system. To gain a mechanistic understanding, they will also conduct empirical data-driven, reality-reproducing computational fluid dynamics (CFD) simulations of the protist-imposed flow fields. The results will be used to test the hypothesis that diversity and flexibility in propulsive morphology facilitates protists to achieve sophisticated swimming behaviors and sensory perception capabilities that adapt them for selective feeding and predator avoidance. These capabilities may also serve as important driving forces for protistan biodiversity, represented by various sizes, shapes, propulsive morphologies and motility patterns.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1129496
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